

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

In the Matter of

Use of Spectrum Bands Above 24 GHz For
Mobile Radio Services

GN Docket No. 14-177

Establishing a More Flexible Framework to
Facilitate Satellite Operations in the 27.5-28.35
GHz and 37.5-40 GHz Bands

IB Docket No. 15-256

Petition for Rulemaking of the Fixed Wireless
Communications Coalition to Create Service
Rules for the 42-43.5 GHz Band

RM-11664

Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95,
and 101 To Establish Uniform License Renewal,
Discontinuance of Operation, and Geographic
Partitioning and Spectrum Disaggregation Rules
and Policies for Certain Wireless Radio Services

WT Docket No. 10-112

Allocation and Designation of Spectrum for Fixed-
Satellite Services in the 37.5-38.5 GHz, 40.5-41.5
GHz and 48.2-50.2 GHz Frequency Bands;
Allocation of Spectrum to Upgrade Fixed and
Mobile Allocations in the 40.5-42.5 GHz
Frequency Band; Allocation of Spectrum in the
46.9-47.0 GHz Frequency Band for Wireless
Services; and Allocation of Spectrum in the 37.0-
38.0 GHz and 40.0-40.5 GHz for Government
Operations

IB Docket No. 97-95

**COMMENTS OF
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I. INTRODUCTION AND SUMMARY

Across the globe, governments, companies, research institutions, and standards bodies are working toward the next generation of mobile services. The Federal Communications Commission (Commission) is leading the way through its efforts to make available additional spectrum in high, medium, and low bands to facilitate development and deployment of 5G services. NCTA – The Internet & Television Association¹ (NCTA) applauds the Commission's Report and Order and Further Notice of Proposed Rulemaking (*Order & FNPRM*) in this proceeding, in which it made 10.86 gigahertz of spectrum newly available for mobile use. In particular, NCTA welcomes the addition of the 64-71 GHz unlicensed band, which will both help to support unlicensed applications that operate today in the adjacent 57-64 GHz band and create more space for the development of new and innovative unlicensed services.

U.S. consumers continue to demand more throughput and the ability to connect a huge array of new devices to their networks. Past data and industry forecasts show that much of this connectivity depends on Wi-Fi and other unlicensed services, and that this dependence will grow. And many analysts suggest that 5G networks will rely on a mix of licensed and unlicensed spectrum as network operators deploy all available spectrum resources to serve larger numbers of users at faster speeds. Consequently, it is more important than ever before to ensure

¹ Formerly known as the National Cable & Telecommunications Association, NCTA is the principal trade association for the U.S. cable industry, representing cable operators serving more than 80 percent of the nation's cable television households and more than 200 cable program networks. The cable industry is the nation's largest provider of broadband service after investing over \$245 billion since 1996 to build two-way interactive networks with fiber optic technology. Cable companies also provide state-of-the-art competitive voice service to approximately 30 million customers.

that consumers, and the innovators who serve them, have access to sufficient unlicensed spectrum resources.

To be clear, unlicensed spectrum in the millimeter wave bands is no substitute for lower unlicensed frequencies. To meet growing consumer demand, the Commission should not only authorize unlicensed use of additional high-band spectrum, but also open the 5.9 GHz band for unlicensed use. No other frequency band presents as attractive a near-term opportunity for easing congestion in today's Wi-Fi bands and connecting more consumers.

NCTA commends the Commission for its focus on facilitating the development of 5G pursuant to a variety of regulatory frameworks. In its *Order & FNPRM*, the Commission “adopt[ed] a balanced licensing approach that includes licensed, unlicensed, and innovative sharing approaches across a variety of bands.”² The Commission can best support 5G innovation by continuing to insist on that balance in the additional bands on which it now seeks comment. In particular, NCTA urges the Commission to designate the 70/80 GHz bands for shared unlicensed use and to adopt its proposed licensing approach in the 32 GHz band. The Commission should also adopt a use-or-share requirement in all licensed Upper Microwave Flexible Use Service (UMFUS) bands in order to encourage build-out by licensees and allow efficient opportunistic use of spectrum at times and in locations where licensees are not operating.

² *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services, et al.*, Report and Order and Further Notice of Proposed Rulemaking, GN Docket No. 14-177, IB Docket Nos. 15-256 & 97-95, RM-11664, WT Docket No. 10-112, FCC No. 16-89 ¶ 31 (rel. July 14, 2016) (*Order & FNPRM*).

II. DEMAND FOR UNLICENSED SERVICES CONTINUES TO GROW AND UNLICENSED WILL FORM AN IMPORTANT PART OF THE 5G ECOSYSTEM

The Commission has repeatedly recognized the central importance of unlicensed spectrum to U.S. consumers and the value that unlicensed services bring to the U.S. economy.³

For instance, the Commission has noted that

unlicensed radio transmitting devices . . . are an important part of this nation's communications capabilities, serving to augment the operations of licensed services and to meet the needs of a wide range of wireless applications. . . . The Part 15 rules . . . ha[ve] provided manufacturers and developers with the

³ *Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (UNII) Devices in the 5 GHz Band*, First Report and Order, 29 FCC Rcd 4127, 4132-33 ¶ 15 (2014) ("U-NII devices . . . play an important role in meeting public demand for wireless broadband service, particularly wireless local area networking and broadband access."); Tom Wheeler, Chairman, FCC, Remarks at the National Press Club, Washington, D.C.: The Future of Wireless: A Vision for U.S. Leadership in a 5G World (June 20, 2016), https://apps.fcc.gov/edocs_public/attachmatch/DOC-339920A1.pdf ("Unlicensed will continue to play a critical role in future 5G networks."); *Statement of Commissioner Mignon L. Clyburn regarding Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, ET Docket No. 13-49 (Mar. 31, 2014), https://apps.fcc.gov/edocs_public/attachmatch/DOC-326341A4.pdf ("[T]here is a consensus that Wi-Fi off load saves wireless companies tens of billions of dollars in network costs each year. Demand for unlicensed services has spiked so much that the 2.4 GHz band is now congested particularly in major cities."); Jessica Rosenworcel, Commissioner, FCC, Remarks at New America Foundation Event "The Road to Gigabit Wi-Fi," Washington, D.C., at 2 (Jan. 12, 2016), https://apps.fcc.gov/edocs_public/attachmatch/DOC-337249A1.pdf ("Wi-Fi is how we foster innovation. That's because the low barriers to entry for unlicensed airwaves make them perfect sandboxes for experimentation."); *Statement of Commissioner Ajit Pai regarding Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, ET Docket No. 13-49 (Mar. 31, 2014), https://apps.fcc.gov/edocs_public/attachmatch/DOC-319025A6.pdf ("Flexible unlicensed spectrum use was one of this country's great innovations . . ."); Michael O'Rielly, Commissioner, FCC, Remarks at New America Foundation Event "The Road to Gigabit Wi-Fi," Washington, D.C., at 1 (Jan. 12, 2016), https://apps.fcc.gov/edocs_public/attachmatch/DOC-337254A1.pdf ("[T]he magic or beauty of unlicensed spectrum . . . [is that] no one can predict the astonishing outcomes that will occur once America's creative geniuses are set free to experiment and innovate.").

flexibility to devise a wide variety of innovative standards and devices, like WiFi and Bluetooth, which are thriving in bands that were formerly considered to be lacking significant commercial value.⁴

NCTA agrees that unlicensed will continue to play an important role in U.S. spectrum policy,⁵ especially given ever-increasing forecasts for consumer and carrier demand for Wi-Fi and other unlicensed services.

Cisco's latest Visual Networking Index notes that in the United States, Wi-Fi accounted for 54.9 percent of total Internet traffic in 2015 and will account for 63.5 percent of total Internet traffic in 2020.⁶ That equates to 889 million gigabytes of data traveling over Wi-Fi every day.⁷ More than 86 million U.S. households contain an active Wi-Fi access point,⁸ and the average U.S. household will have thirteen different connected devices by 2019.⁹

⁴ *Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, Report and Order, 29 FCC Rcd 6567, 6681 ¶ 259 (2014).

⁵ *See, e.g.*, Comments of the National Cable & Telecommunications Association, GN Docket No. 14-177, RM-11664, at 7-9 (filed Jan. 15, 2015); Comments of the National Cable & Telecommunications Association, ET Docket No. 13-49, at 3-7 (filed May 28, 2013); Comments of the National Cable & Telecommunications Association, GN Docket No. 12-354, at 6-9 (filed Feb. 20, 2013); Comments of the National Cable & Telecommunications Association, GN Docket No. 12-268, at 2-4 (filed Jan. 25, 2013).

⁶ CISCO, *VNI Complete Forecast Highlights Tool*, North America, United States, Wired Wi-Fi and Mobile Growth (2016), http://www.cisco.com/c/m/en_us/solutions/service-provider/vni-forecast-highlights.html (select "United States" from the "North America" drop-down menu, select "2020 Forecast Highlights" and expand "Wired Wi-Fi and Mobile Growth").

⁷ *See id.* (select "North America" drop-down menu, then select "United States," and expand "Internet Traffic").

⁸ SNL KAGAN, *U.S. Wi-Fi Household Projections* (2016).

⁹ IHS MARKIT, *Nine in 10 Global Broadband Households to Have Service Provider Wi-Fi by 2019*, *IHS Says* (June 5, 2015), <http://press.ihs.com/press-release/technology/nine-10-global-broadband-households-have-service-provider-wi-fi-2019-ihs-sa>.

Given rising consumer demand for Wi-Fi, the cable industry has invested heavily to expand its Wi-Fi deployments. NCTA's members have deployed more than 500,000 shared CableWi-Fi hotspots¹⁰—among a total of approximately 16 million public cable Wi-Fi hotspots—that rely on unlicensed spectrum. In just one month, these hotspots support more than 1.7 billion active sessions, transmitting and receiving more than 101 petabytes of data.

Many analysts also explain that unlicensed spectrum will play an important role in 5G networks. Experts from Nokia and Intel point to the importance of Wi-Fi and the IEEE 802.11 standards effort today and argue that unlicensed has “huge potential” for 5G, including for Internet of Things applications.¹¹ Similarly, 4G Americas states that “[t]he use of unlicensed spectrum is an important complement for all 5G systems and deployments, particularly in small cell deployments.”¹² Cisco notes that 5G networking will rely on integrating and/or aggregating different radio access technologies that operate in both licensed and unlicensed spectrum.¹³ As

¹⁰ See <http://www.cablewifi.com>.

¹¹ *5G to Embrace Unlicensed Bands and Wi-Fi*, Mobile World Live (Feb. 24, 2016), <http://www.mobileworldlive.com/mwc16-articles/5g-to-embrace-unlicensed-bands-and-wi-fi/>; see also Nokia, *FutureWorks Looking Ahead to 5G: Building a Virtual Zero Latency Gigabit Experience*, White Paper, at 3 (2014), <http://resources.alcatel-lucent.com/asset/200014> (“[5G] will be a combination of existing [Radio Access Technologies (RATs)] in both licensed and unlicensed bands, plus one or more novel RATs optimized for specific deployments, scenarios and use cases.”).

¹² 4G Americas, *5G Spectrum Recommendations*, White Paper, at 11 (Aug. 2015), http://www.4gamericas.org/files/6514/3930/9262/4G_Americas_5G_Spectrum_Recommendations_White_Paper.pdf.

¹³ See generally CISCO, *Cisco 5G Vision Series: Licensed, Unlicensed, and Access-Independent Networks* (May 23, 2016), <http://www.techinvestornews.com/Mobile/Latest-Mobile-News/cisco-5g-vision-series-licensed-unlicensed-and-access-independent-networks>; see also Open Air Interface, <http://www.openairinterface.org> (from the 5G Strategic Areas drop-down

Recode describes it, “5G is going to represent a mix of licensed and unlicensed spectrum . . . continu[ing] . . . down the path of narrowing the delta between Wi-Fi and cellular networks.”¹⁴

While a licensed standard for 5G may not be ready until the end of 2019,¹⁵ unlicensed standards have already been developed for use in the millimeter wave bands, including WirelessHD and IEEE 802.11ad. Improvements to IEEE 802.11ad are already in the pipeline to accommodate new throughput, range, and use cases.¹⁶ Products using the 802.11ad standard (also known as WiGig) are expected to facilitate high speed “video streaming, wireless docking, huge file transfers, [and] instantaneous wireless backups,”¹⁷ while WirelessHD “enables wireless streaming of High-Definition (HD) audio, video and data between source devices (e.g., DVRs

menu, select “Heterogeneous 5G Networks”) (noting that “5G wireless network design will see lot of convergence happening between LTE/WiFi networks”).

¹⁴ Mark Lowenstein, *Here Comes 5G – But First, a Reality Check*, RECODE (Jul. 25, 2016), <http://www.recode.net/2016/7/25/12266072/5g-wireless-broadband-spectrum-reality-check-fcc-internet-of-things>.

¹⁵ Dan Jones, *3GPP Plans Early Mobile 5G Spec for December 2017*, LIGHT READING (Sept. 8, 2016), <http://www.lightreading.com/mobile/5g/3gpp-plans-early-mobile-5g-spec-for-december-2017/d/d-id/725979> (noting that while 3GPP’s Non-Standalone-New Radio specification could be ready by December 2017, Phase II release of the New Radio specification is not scheduled to occur until the fourth quarter of 2019).

¹⁶ Comments of Intel Corporation at 17-18 (filed Jan. 27, 2016) (Intel Comments) (discussing the IEEE 802 standards project, 802.11ay, which will improve on the 802.11ad standard); Comments of IEEE 802 at 4 (filed Jan. 27, 2016) (IEEE 802 Comments) (same). Unless otherwise noted, all comment citations herein are to comments filed on January 28, 2016 and all reply comment citations herein are to reply comments filed on February 26, 2016 in GN Docket No. 14-177, IB Docket No. 15-256, RM-11664, WT Docket No. 10-112, and IB Docket No. 97-95.

¹⁷ Wi-Fi Alliance, *WiGig® and Health/Safety*, at 4 (2015), https://www.wi-fi.org/download.php?file=/sites/default/files/private/WiGig_and_Health_Brochure_2015.pdf.

and gaming consoles) and displays (e.g., HDTVs and monitors).”¹⁸ These existing standards are just a taste of the coming proliferation of unlicensed 5G services.

III. THE COMMISSION SHOULD AUTHORIZE UNLICENSED USE IN THE 70/80 GHZ BANDS

The Commission can protect incumbent operations and encourage the development of innovative new 5G services by authorizing unlicensed use of the 70/80 GHz bands.¹⁹ Wi-Fi devices are designed to share spectrum with other users. With appropriate technical rules in place, these devices are well positioned to protect incumbent fixed point-to-point links, Fixed Satellite Service (FSS), radio astronomy, and Earth Exploration Satellite Service (EESS) operations from harmful interference. Importantly, unlike the proposed three-tier approach, authorizing unlicensed use would be less complex, costly, and risky to implement.

If, however, the Commission goes forward with its plans to authorize mobile use of the band using a more complicated three-tier access system, it should, at the least, extend the upper edge of the current 57-71 GHz unlicensed band up to 72.5 GHz. This small change would allow for the use of an additional IEEE 802.11ad channel, further broadening the opportunities for

¹⁸ WIRELESSHD CONSORTIUM, *About, Technology, Introduction to WirelessHD™ Technology* (2016), <http://www.wirelesshd.org/about/technology/>.

¹⁹ See Comments of Dynamic Spectrum Alliance at 1, 3; Comments of Microsoft Corporation at 18 (Microsoft Comments); Comments of Wi-Fi Alliance at 9-10; Reply Comments of Microsoft Corporation at 4-6, 10-11; Reply Comments of the National Cable & Telecommunications Association at 14 (NCTA Reply Comments); Reply Comments of Qualcomm Incorporated at 8.

innovative unlicensed services in millimeter wave spectrum, and would not materially reduce the utility of the remainder of the band.

A. The Commission Should Authorize Unlicensed Use of the 71-76 GHz and 81-86 GHz Bands

The Commission proposes a database-facilitated, three-tier access system for enabling mobile users of the 70/80 GHz bands to share with incumbent fixed, FSS, radio astronomy, and EESS users.²⁰ In NCTA's view, the proposed approach is more complex than required to accomplish the Commission's goal of freeing up spectrum for shared mobile use while ensuring that incumbent users are protected.²¹ Instead, the Commission should authorize unlicensed users to operate in the bands under a simpler set of technical rules, which would prevent harmful interference to incumbents while promoting innovation and facilitating the development of consumer devices.

NCTA's members believe that, in the near term, the 70/80 GHz bands are well-positioned for use by unlicensed fixed point-to-point links and for short-range, indoor applications like WirelessHD and 802.11ad. The 71-76 GHz band, in particular, presents an opportunity for unlicensed use because of its location immediately adjacent to the new 64-71 GHz unlicensed band. A wide swath of contiguous unlicensed spectrum from 57-76 GHz under similar technical rules would allow additional channel aggregation to support very high bandwidth applications and accommodate large numbers of simultaneous users. Moreover, unlicensed standards have

²⁰ *Order & FNPRM* ¶¶ 131, 440.

²¹ *Id.* ¶¶ 372-74.

already been developed for the 57-64 GHz band, and the IEEE has begun to revise them for new throughput, range, and use cases.²²

The Commission can authorize unlicensed devices to operate in the 70/80 GHz bands under Part 15 technical rules designed to protect incumbent operators while still providing sufficient flexibility to both accommodate existing unlicensed millimeter wave technologies and encourage the development of innovative new unlicensed services, including nomadic mobile services capable of operating both indoors and outdoors. NCTA suggests that the Commission use as a starting point the existing Section 15.255 rule that governs unlicensed operations in the 57-64 GHz band (and will also govern operations in the 64-71 GHz band, once the Commission's new rules take effect). Section 15.255 sets forth different options for different services, allowing higher power, point-to-point operations outdoors as well as an option for lower power services.²³ Fixed point-to-point unlicensed operations could coordinate with incumbent fixed point-to-point users in areas where those users are concentrated.²⁴ Unlicensed operations at lower power levels, especially indoors, are unlikely to cause harmful interference to incumbents, given the limited propagation of millimeter wave spectrum. Using Section 15.255 as a starting point for developing unlicensed technical rules for the 70/80 GHz bands would work well for existing use cases, but is also flexible enough to accommodate new applications. Note

²² Intel Comments at 17-18, IEEE 802 Comments at 4.

²³ 47 C.F.R. § 15.255.

²⁴ *See, e.g.*, 47 C.F.R. § 101.1523 (describing the coordination process for Part 101 fixed point-to-point licensees); *see also Order & FNPRM* ¶ 432 (noting that only 16 counties have “an average site density of more than one [fixed point-to-point] transmission or reception site per square mile, and those 16 counties contain 73 percent of all registered transmitters and receivers in the 71-76 and 81-86 GHz bands”).

that whatever technical rules the Commission adopts, it should authorize channel bandwidths of at least 200 megahertz to accommodate a variety of high-bandwidth applications anticipated for the millimeter wave bands.

If the Commission finds that the Section 15.255 rules, standing alone, are insufficient to protect 70/80 GHz band incumbents, it could employ a variety of technical approaches that it has used in other unlicensed bands (and that have already been implemented in today's unlicensed equipment). For instance, the Commission could require unlicensed 70/80 GHz devices to:

(1) implement a cognitive radio form of channel selection to ensure that unlicensed devices automatically scan available channels and select an empty or least-used channel before operating²⁵; (2) employ contention-based politeness protocols (similar to the IEEE 802.11 Clear Channel Assessment) that cause an unlicensed device to back off in the presence of an incumbent signal²⁶; (3) limit transmit power and antenna gain with the option to increase directional antenna gain only if transmit power is reduced²⁷; (4) respect appropriately sized

²⁵ See, e.g., 47 C.F.R. § 15.233(b)(2)(i) (“Cordless telephones operating on channels one through fifteen must: (i) Incorporate an automatic channel selection mechanism that will prevent establishment of a link on any occupied frequency.”).

²⁶ See, e.g., 47 C.F.R. §§ 90.1305, 90.1319; *Amendment of the Commission’s Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Report and Order and Second Further Notice of Proposed Rulemaking, 30 FCC Rcd 3959, 3965-66 ¶ 19 n.28 (2015) (“Contention-based protocol is a protocol that allows multiple users to share the same spectrum by defining the events that must occur when two or more transmitters attempt to simultaneously access the same channel and establishing rules by which a transmitter provides reasonable opportunities for other transmitters to operate.” (citing 47 C.F.R. § 90.7)) (*3.5 GHz Order*).

²⁷ See, e.g., 47 C.F.R. § 15.407(a)(3) (“If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral

exclusion or coordination zones around relevant incumbent operations; and/or (5) implement emissions limits sufficient to protect adjacent users. Unlicensed devices successfully use these methods today to share equitably with one another and to protect incumbent operations. With appropriate technical rules in place, unlicensed users would be well-placed to share the 70/80 GHz bands.

If the Commission goes forward with its three-tier spectrum access system (SAS) approach instead, it should (1) authorize traditional Part 15 unlicensed operation indoors,²⁸ and (2) implement the approach in phases, beginning with a two-tier system focusing on shared use between incumbents and opportunistic users. In the millimeter wave frequencies, low-power unlicensed signals will not penetrate walls or other obstructions and would likely operate at very short range. Indoor, low-power devices therefore would not pose an interference threat to incumbent signals outside the room in which the unlicensed devices transmit. Moreover, because traditional Part 15 equipment is less complicated than equipment that must comply with an SAS sharing approach, it is likely to be less expensive. The availability of less expensive equipment would broaden the possibilities for economically viable 5G applications, including for set-top boxes and connected home applications. The Commission can therefore preserve maximum flexibility for the development of creative 5G services by authorizing indoor Part 15 unlicensed operations alongside any three-tier access system.

density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.”).

²⁸ See *Order & FNPRM* ¶ 440.

The Commission should also implement any three-tier approach in phases, focusing at the outset on sharing between incumbents and opportunistic users (including General Authorized Access (GAA) and indoor Part 15 operations). As the Commission noted in the 3.5 GHz proceeding, limiting the sharing approach only to opportunistic users and incumbents helps to “minimize disruption to incumbent operators.”²⁹ In order to decrease possible sources of interference and reduce uncertainty and inconvenience for incumbent users, the Commission should only add a third tier of licensed users once successful sharing between incumbents and GAA/Part 15 users has been established.

B. The Commission Should Extend the Current 64-71 GHz Unlicensed Band to 72.5 GHz

As recommended by Microsoft, the Information Technology Industry Council, the Open Technology Institute, and Public Knowledge, the Commission should extend the upper boundary of the new 64-71 GHz band to 72.5 GHz.³⁰ As Microsoft has demonstrated, this small change would allow for a total of seven non-overlapping 802.11ad channels, facilitating optimal utilization of the extended 60 GHz band spectrum.³¹ If the Commission does not make this change, 800 megahertz of spectrum from 70.2 GHz to 71 GHz would essentially lie fallow, as

²⁹ See *3.5 GHz Order*, 30 FCC Rcd at 4079 ¶ 410.

³⁰ See Microsoft Comments at 5-7; Comments of Open Technology Institute at New America and Public Knowledge, GN Docket No. 14-177, at 29 (filed Jan. 28, 2016) (OTI & PK Comments); Comments of the Information Technology Industry Council, GN Docket No. 14-177, at 7 (filed Jan. 27, 2016); see also *Order & FNPRM* ¶ 131.

³¹ Microsoft Comments at 5.

this spectrum would go unused under the 802.11ad channelization scheme.³² The Commission should avoid this inefficient result by extending the new 64-71 GHz unlicensed band to 72.5 GHz.

The Commission expresses concern regarding methods for unlicensed users to share with incumbents in the 71-72.5 GHz band.³³ For the reasons discussed in Part III.A, above, unlicensed users are well-positioned to share these frequencies with incumbents, whether in the entire 70/80 GHz range, or only in 71-72.5 GHz. Moreover, now is the perfect time to implement this change, as the band is “relatively lightly used” by fixed point-to-point users and other incumbents.³⁴ Such a change would be more difficult to implement after the Commission authorizes new mobile operations.

IV. THE COMMISSION SHOULD ADOPT ITS PROPOSAL TO AUTHORIZE LICENSED MOBILE USE OF THE 32 GHZ BAND

NCTA supports the Commission’s proposal to authorize licensed mobile use of the 32 GHz band. The propagation characteristics of this spectrum are comparable to the 28 GHz band that the Commission already made available under its new UMFUS rules, and the 32 GHz band would consequently present comparable additional spectrum that could be easily integrated into licensees’ 5G networks. Moreover, the band offers 1,600 megahertz of contiguous spectrum,³⁵ which could comfortably accommodate the wide channels anticipated for high-

³² See OTI & PK Comments at 29.

³³ Order & FNPRM ¶ 131.

³⁴ See *id.* ¶ 432.

³⁵ See *id.* ¶ 373.

bandwidth 5G services. Many commenters agree that the 32 GHz band presents an interesting opportunity for mobile use.³⁶

Although there is not currently a mobile allocation for 32 GHz, NCTA believes that this should not pose a barrier to adopting rules for mobile services in the band. As the Commission points out, the International Telecommunication Union’s 2015 World Radiocommunication Conference (WRC) “decided to conduct the appropriate sharing and compatibility studies for the 32 GHz band, which may lead to an allocation for mobile service in the 32 GHz band at WRC-19.”³⁷ Because five out of six regional groups supported studying the 32 GHz band for mobile use,³⁸ prospects for a mobile allocation at WRC-2019 appear favorable so long as appropriate sharing criteria can be identified.

The sophisticated mitigation techniques that exist today, or those currently under development, could serve as a starting point for addressing coexistence between new 32 GHz mobile licensees and incumbent users. For example, exclusion or coordination zones could potentially be used to protect federal radar operations. While such zones may not be appropriate for the protection of aeronautical radar operations at 32 GHz, they present a more interesting possibility for protecting maritime radar operations, depending upon the specific characteristics

³⁶ Comments of Avanti Communications Group PLC at 7-8; Comments of the EMEA Satellite Operators Association at 8 (ESOA Comments); Comments of the Global VSAT Forum at 4-5; Comments of Nokia at 12; Comments of Samsung Electronics America, Inc. and Samsung Research America at 15 (Samsung Comments).

³⁷ *Order & FNPRM* ¶ 389.

³⁸ Samsung Comments at 16 (the five regional groups include the Asia-Pacific Telecommunity, the Arab States, Europe, the Inter-American Telecommunication Commission, and the Regional Commonwealth in the field of Communications).

of the systems at issue.³⁹ The Commission has also adopted technical rules in the 3.5 GHz band for Priority Access Licensees and GAA users to protect federal shipborne radar using an environmental sensing capability coupled with a spectrum access system database.⁴⁰ Potential unlicensed users of the 5 GHz U-NII-2B band believe that they can protect federal radar operations using dedicated radar signal detectors and other techniques.⁴¹ These existing techniques could potentially be adapted to allow mobile licensees to protect U.S. Government radars that operate in the 32 GHz band.

EESS operations take place in the adjacent 31.3 to 31.8 GHz band, so the FCC could adopt an appropriate out-of-band emissions (OOBE) limit to prevent harmful interference from new 32 GHz mobile licensees. For example, the Commission found that the OOBE limit it adopted for 37 GHz UMFUS licensees was sufficient to protect adjacent EESS operations.⁴² If an OOBE limit is not sufficient here, a database approach could likely be used to protect EESS. Potential unlicensed users of the U-NII-2B band, for instance, anticipate that a database solution could prevent unlicensed operations at times when and in areas where the satellites are passing

³⁹ See, e.g., U.S. DEP'T OF COMMERCE, Nat'l Telecomms. and Info. Admin., *An Assessment of the Near-Term Viability of Accommodating Wireless Broadband Systems in the 1675-1710 MHz, 1755-1780 MHz, 3500-3650 MHz, and 4200-4220 MHz, 4380-4400 MHz Bands*, 1-6 to 1-7 (Oct. 2010), http://www.ntia.doc.gov/files/ntia/publications/fasttrackevaluation_11152010.pdf.

⁴⁰ 47 C.F.R. § 96.15.

⁴¹ See Letter from Paul Margie, Counsel to Google Inc., to Marlene H. Dortch, Secretary, FCC, ET Docket No. 13-49, at Attachment (filed Apr. 7, 2014) (Google Letter). In other portions of the 5 GHz band, Wi-Fi devices use Dynamic Frequency Selection to vacate a channel when a device detects the presence of federal radar operations. 47 C.F.R. § 15.407(h)(2).

⁴² *Order & FNPRM* ¶ 157.

overhead.⁴³ The Committee on Radio Frequencies (CORF) acknowledges as a general matter that such “time sharing of the band; e.g., dynamic scheduling to accommodate frequent passes overhead,” could conceivably protect EESS operations.⁴⁴

An appropriate OOB limit may also be sufficient to protect adjacent radio astronomy operations.⁴⁵ Alternatively, the Commission could, as it did in the 600 MHz band, develop appropriate exclusion zones to protect radio astronomy.⁴⁶ As CORF explains, “RAS bands can be protected regionally by limiting emissions within a certain radius of a facility.”⁴⁷ Appropriately sized exclusion or coordination zones could likely protect both adjacent radio astronomy operations and the one co-channel space research facility operating in the 32 GHz band.⁴⁸ Although many of the mitigation techniques discussed above were designed to facilitate sharing between unlicensed services and incumbents, NCTA believes that they could serve as a starting point for developing appropriate sharing mechanisms for new UMFUS licensees to protect 32 GHz incumbents.

NCTA agrees that the Commission should adopt the same licensing and service framework for the 32 GHz band as it has adopted for other bands in the UMFUS, including

⁴³ Google Letter at Attachment.

⁴⁴ Comments of the National Academy of Sciences’ Committee on Radio Frequencies at 5 (CORF Comments).

⁴⁵ *See Order & FNPRM* ¶ 158 (concluding that an OOB limit for 37 GHz UMFUS users was sufficient to protect adjacent radio astronomy operations).

⁴⁶ 47 C.F.R. § 15.712(h).

⁴⁷ CORF Comments at 5; *see also* ESOA Comments at 8-9.

⁴⁸ *See Order & FNPRM* ¶ 386.

channel bandwidths of at least 200 megahertz.⁴⁹ This will promote equipment economies of scale and simplify the application and deployment process for licensed users that wish to incorporate multiple millimeter wave bands into their 5G networks.

V. THE COMMISSION SHOULD ADOPT A USE-OR-SHARE REQUIREMENT IN LICENSED BANDS ABOVE 24 GHZ THAT WILL ENCOURAGE LICENSED BUILD-OUT AND UNLICENSED INVESTMENT

NCTA agrees that, “given the propagation characteristics, and high potential for re-use, of the mmW spectrum,” “a use-or-share regime may have the potential to enhance the efficiency and productivity of spectrum, if properly implemented.”⁵⁰ The Commission focuses in the *Order & FNPRM* primarily on the implementation of use-or-share as a performance requirement that will incent licensees to build out their networks. However, to the extent that use-or-share requirements are also intended to “put [spectrum] to efficient and productive use,”⁵¹ the Commission must ensure that its use-or-share rules make available sufficient spectrum to justify investment by opportunistic users.

NCTA supports adopting an unlicensed shared access approach to use-or-share in the millimeter wave bands, which could be implemented using a database.⁵² As the Commission has noted in the context of other bands, “permitting opportunistic access to unused [licensed] channels would maximize the flexibility and utility of the . . . [b]and. . . [and] would ensure that

⁴⁹ See *id.* ¶ 375.

⁵⁰ *Id.* ¶ 474.

⁵¹ *Id.* ¶ 471.

⁵² See *id.* ¶¶ 477, 480.

the band will be in consistent and productive use.”⁵³ A database can enable unlicensed operations where and when a licensee is not operating down to a much more granular level than would be possible through traditional coordination or using pre-defined geographic areas. Accordingly, database-enforced unlicensed shared access would maximize spectrum available to opportunistic users and result in the most efficient use of spectrum. An unlicensed approach facilitated by a database would also keep barriers to entry low for potential opportunistic users as compared to a more traditional frequency coordination mechanism.⁵⁴

As it did in the 3.5 GHz proceeding, the Commission should adopt an engineering-based definition of “use” in order to maximize the spectrum available for efficient opportunistic operations.⁵⁵ For example, defining a protection contour based upon the registered characteristics of a licensee’s network deployments will ensure that the Commission extends protection only to areas where a licensee has actually deployed equipment that is actively serving customers. This would both encourage licensees to deploy more equipment to serve more customers and make available the most remaining spectrum for opportunistic unlicensed operations.

⁵³ *Amendment of the Commission’s Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Order on Reconsideration and Second Report and Order, 31 FCC Rcd 5011, 5060 ¶ 176 (2016) (*Second 3.5 GHz Order*).

⁵⁴ *See Order & FNPRM* ¶ 478 (discussing a possible frequency coordination approach to use-or-share).

⁵⁵ *Id.* ¶ 481; *Second 3.5 GHz Order*, 31 FCC Rcd at 5060 ¶ 174; *see also* NCTA Reply Comments at 17.

The Commission should not “set some level at which a subdivision of a license area would be declared ‘used’ in its entirety and off-limits to opportunistic use” in an effort to allow a licensee room to expand its deployments.⁵⁶ If the Commission selects an arbitrary geographic area that it deems “used,” the protection area would bear little relationship to a licensee’s actual deployments, undermining the utility of “use-or-share” as a build-out incentive. This approach would also potentially exclude unlicensed users from broad swaths of territory where a licensee is not actually operating a network, reducing the efficient use of the band. If the Commission adopts a database-driven sharing mechanism, the database can respond dynamically to prevent unlicensed operations in areas with new licensee facilities as soon as those facilities are registered and begin to transmit.

The technical rules for unlicensed shared access should, to the extent possible, mirror the operational rules adopted for millimeter wave bands that the Commission has designated for unlicensed use.⁵⁷ In this way, opportunistic users can minimize their equipment development costs by starting with existing equipment designed to operate at similar frequencies under similar rules. If the Commission deems this approach infeasible, it should allow unlicensed users to operate pursuant to the same technical rules as UMFUS licensees in the band at issue in order to maximize equipment economies of scale for both licensees and opportunistic users.⁵⁸

⁵⁶ *Order & FNPRM* ¶ 481.

⁵⁷ *See id.* ¶ 480.

⁵⁸ *Id.* ¶ 477.

The Commission inquires whether there will be “sufficient scale to drive more special-purpose equipment development” for secondary or unlicensed users of licensed UMFUS bands.⁵⁹ NCTA suggests above that the Commission can encourage unlicensed innovators to invest in equipment development for these bands by (1) adopting a use-or-share approach that maximizes spectrum available for database-enforced opportunistic use, and (2) adopting technical rules similar to those used in other unlicensed millimeter wave bands. However, the Commission can also ensure sufficient scale to promote investment by authorizing widespread indoor unlicensed operations under Part 15 throughout the licensed UMFUS bands without the need for database coordination. As described in further detail in Part III.A, above, indoor low-power unlicensed use poses very little risk of harmful interference to incumbents in these bands due to the limited propagation of millimeter wave spectrum. With appropriate Part 15 rules in place, the Commission can authorize more intense and efficient use of the licensed millimeter wave bands while ensuring sufficient spectrum availability and scale to justify investment in unlicensed equipment. The Commission should adopt the approaches set forth above in order to make its use-or-share regime an economically viable proposition for prospective unlicensed users.

VI. CONCLUSION

In order to encourage efficient use of spectrum and provide the most flexible regulatory environment in the millimeter wave bands to support 5G services, the Commission should: (1) designate the 70/80 GHz bands for unlicensed use; (2) authorize licensed use of the 32 GHz band; and (3) adopt a use-or-share requirement that properly balances incentives for licensees to

⁵⁹ *Id.* ¶ 480.

build out their networks with incentives for efficient opportunistic users to deploy their own services in unused portions of the UMFUS bands.

Respectfully submitted,

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